FINAL REPORT

OF

INVESTIGATION OF PEARL RIVER DATA COLLECTION SYSTEM APPLICATIONS

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PREPARED FOR

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PEARL RIVER DATA COLLECTION SYSTEM

INTRODUCTION AND OBJECTIVES

Section 106 of the Federal Water Pollution Control Act, as amended (P. L. 92-500), provides for the establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor and to compile and analyze data on the quality of navigable waters.

Pursuant to this provision, a cooperative agreement was reached in late 1974 between the Mississippi Air and Water Pollution Control Commission (MAWPCC), Marshall Space Flight Center (MSFC), National Space Technology Laboratories (NSTL), and the Pearl River Basin Development District (PRBDD) for the placement, operation and maintenance of a number of NASA developed data collection platforms (DCP's) on the Pearl River, and the reception, processing, and retransmission of water quality data from an ERTS satillite to the MAWPCC via computer linkup.

It was the objective of this project to demonstrate and evaluate the reliability of employing NASA developed remote sensing DCP's for in situ near real time monitoring of water quality in the Pearl River.

DESCRIPTION OF THE STUDY AREA

The Pearl River Basin shown in Figure 1 is located in east-central and south-central Mississippi and in the south-eastern part of Louisiana. The Pearl River, flowing from its origin to the Gulf of Mexico, is over 643.6 kilometers (400 miles) long and drains approximately 22,688 square kilometers (8,760 square miles) of surface area.

As a broad view, the Pearl River Basin may be divided into two segments. The Upper Pearl River Basin begins at its headwaters and continues to the vicinity of Byram, Mississippi. In this section lies the two physiographic regions known as the North Central Hills and the Jackson Prairie. There is relatively little base flow to the Pearl River in these two regions. Consequently, the river is very shallow during the summer months and early fall. River banks vary from 3.65 to 12.19 meters (12 to 40 feet) high and the channel width varies from 30.4 to 121.9 meters (100 to 400 feet). Within this section is the Ross Barnett Reservoir, an impoundment of some 121.38 square kilometers (30,000 acres), located just north of Jackson, Mississippi, and extending some 691 kilometers (43 miles) in length.

The upper group of DCP's, consisting of three of the four buoys, is located within that portion of the Pearl River from the Ross Barnett Reservoir Dam south to approximately Tuckers Bluff, encompassing roughly 40.2 kilometers (25 river miles) as shown in Figure 2.

The hydrology of the Pearl River within the study area is entirely dependent upon the operation of the Ross Barnett Reservoir Dam. Annual precipitation in the Jackson area averages approximately 1.2 meters (50 inches), most of which falls from December through May. During the extremely dry months of August through October, the river is so low that navigation with anything but the smallest of boats is impossible. The river has a 7-day, 10-year low flow of 2.5 m^3/sec (89 cfs), but the permit by which operation of the Barnett Reservoir is authorized stipulates a minimum spillway discharge of 4.8 m^3/sec (173 cfs). Although the annual average discharge for the Pearl River at Jackson is 110.4 m^3/sec (3,900 cfs), the average discharge during the study period was much higher due to the unusual amount of rainfall which occurred.

The Lower Pearl River Basin begins at Byram, Mississippi, and continues south to its estuarine mouth. The two physiographic regions which lie in this segment are the Southern Pine Hills and Pine Meadows. Geologic formations within these two regions provide a considerable amount of base flow. Although the drainage area of the Lower Pearl River Basin is less than twice that of the Upper Pearl River Basin, the baseflow contributed to the Pearl River by the lower section is ten times that of the upper section. Banks are much steeper in the lower section, varying from 6.09 to 27.43 meters (20 to 90 feet) high.

A fourth DCP is located in this lower segment near Monticello, Mississippi, approximately 321.8 kilometers (200 river miles) from the mouth of the West Pearl River. The 7-day, 10-year low flow of the Pearl River at the point of deployment (ICRR Trestle) is approximately 8.49 m^3/sec (300 cfs). Annual average precipitation is about 1.42 meters (56 inches), with runoff resulting in an average annual flow of approximately 172.69 m^3/sec (6,100 cfs).

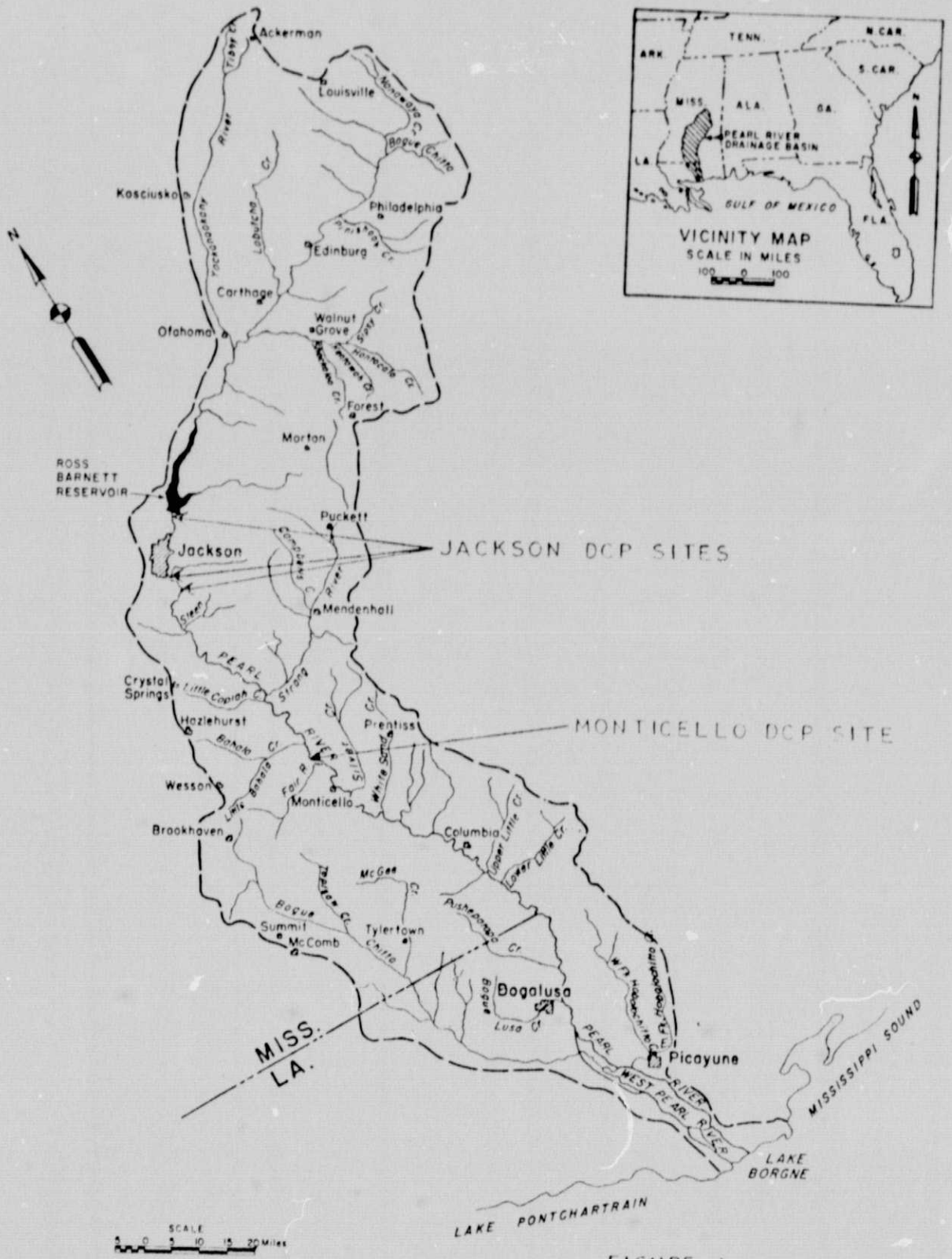

FIGURE 1

PEARL RIVER BASIN

LOCATION MAP

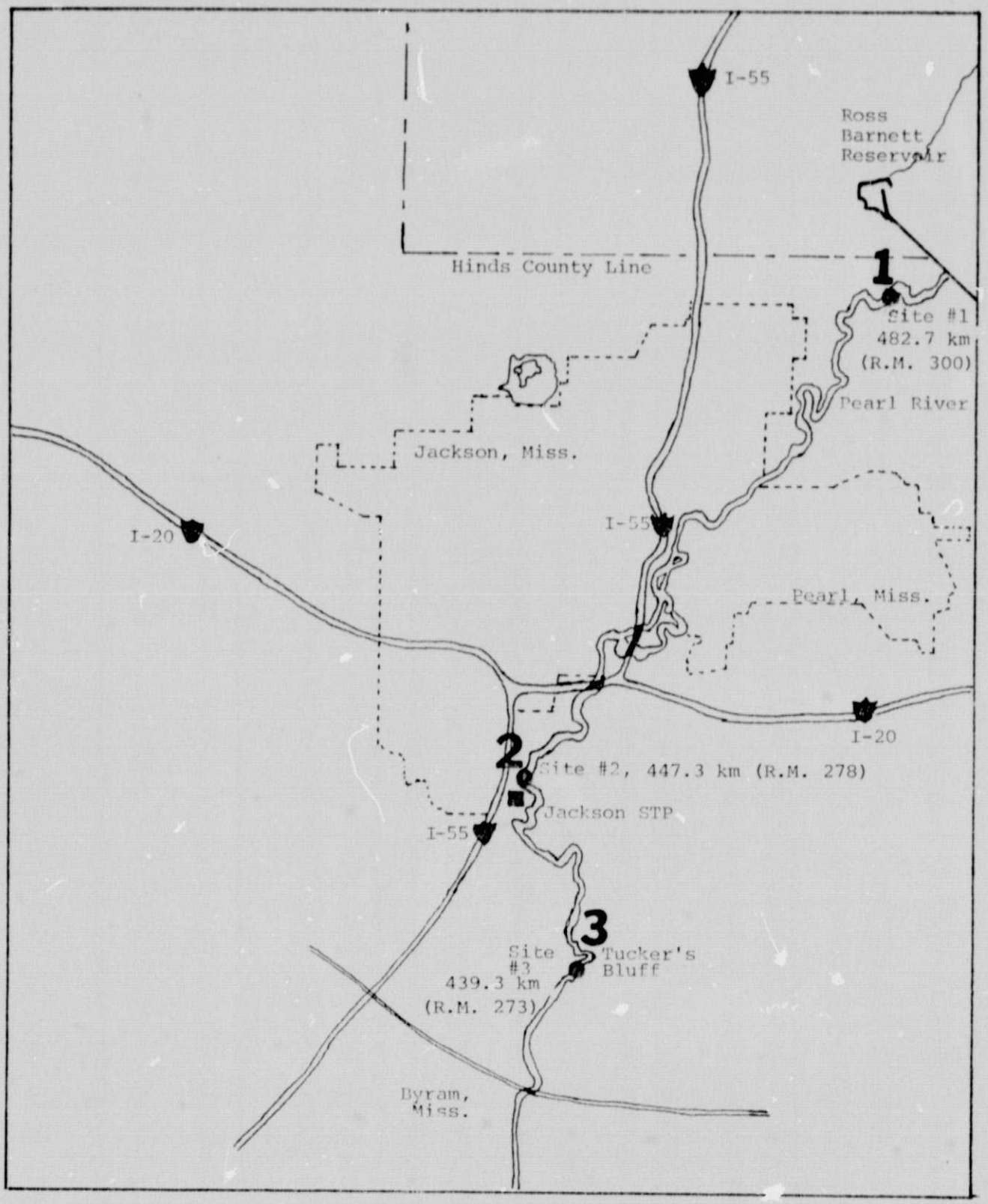

FIGURE 2

ACTUAL LOCATION OF DCP'S NEAR JACKSON, MISS.

HISTORY OF THE PROJECT

In February, 1975, personnel were secured by Pearl River Basin Development District to provide support services to the Mississippi Air and Water Pollution Control Commission as per the District's responsibilities delineated in the no-cost contract executed by and between Mississippi Air and Water Pollution Control Commission and the National Aeronautics and Space Administration. Certain of the personnel were oriented to the Pearl River Data Collection System and the specific equipment to be provided by NASA during the month of March, 1975. The buoys, canisters, and soft ware were received during the latter portion of the month of March and early April. While equipment was being received, combined personnel of Mississippi Air and Water Pollution Control Commission and the Pearl River Basin Development District spent time cruising the river, flagging prospective locations for deployment of the water quality monitoring buoys, as well as potential launching sites for the water going craft. During the second and third weeks of April, under the supervision of Marshall Space Flight Center the initial data collection platform was deployed approximately 2.41 kilometers (1.5 miles) south of the spillway of the Ross Barnett Reservoir in North Jackson. The data collection platform was anchored by a 680.4 kilogram (1500 pound) concrete Coast Guard anchor connected by a combination of chain and stainless steel cable. The necessary soft ware was installed and calibrated and the first transmission received on April 17, 1975.

Within the next 30 days, two more data collection platforms were deployed and activated in the Jackson vacinity. An additional 226.8 kilogram (500 pound) anchor was tied in series to the 680.4 kilogram (1500 pound) concrete Coast Guard anchor to provide additional anchorage security. However, in the course of the next 90 days, flash floods and sudden rises in the river, some as much as 7.62 meters (25 feet) in a three day period, inflicted considerable damage to two of the data collection platforms. In particular, one data collection platform was broken free from the anchor system apparently by a large floating tree trunk or other large debris in the river and found capsized approximately three miles downstream from its anchor point. The data collection platforms were capsized in place with severe water damage absorbed as a result of the canisters being submerged and water infiltrating the breather tube and the seals to the canisters.

The initial data collection platforms consisted of aluminum floats filled with styrofoam for buoyancy, antenna mount attached squarely in the center and on top thereof, tied by cable and chain to a stainless steel (water tight) canister which housed the soft ware of the system. A cable linking the transmitter to the antenna provided the necessary interconnection of the system for transmission purposes.

Subsequent to the problems encountered by inundation of the data collection platforms, Marshall Space Flight Center provided a redesigned antenna float, which also housed the

soft ware in watertight boxes mounted on the float deck The redesigned floats provided a more practical and workable approach to maintenance of the data collection system. The desirability of the single-unit float system versus the two part system as initially deployed revolves primarily around the fact that deployment of one piece of equipment is obviously less complicated than deployment of two where size does not make the former impractical. In addition, vandalism can be reduced by the fact that there is no linkage between the two earlier employed units, which might invite disconnection or other similar tampering.

At this point, transmissions had been sporadically received from the National Space Technology Laboratories in Hancock County, Mississippi. However, as a result of the physical problems of deployment, little continuity had been achieved through use of the Pearl River Data Collection System. In September, 1975, a quick evaluation of work accomplished since the inception of the system revealed that the principal problems resulted not from inadequacies of the equipment or the concept of the system, but rather the physical elements presented by the Pearl River.

During fall of 1975 and early spring of 1976, the three data collection platforms deployed in the Jackson area performed adequately utilizing the Hydrolab equipment. It is reasonable to state that the results provided by the Hydrolab readings did conform to the independent measurements when taken and provided an efficient and accurate method for

the collection of data. From time to time, old and worn out elements of the Hydrolab systems required service maintenance. The only route for servicing the Hydrolab equipment was by shipment of the sensor to Marshall Space Flight Center for subsequent transmittal to the home plant in Texas. The delay experienced by such necessities averaged about six weeks per unit. All units at one time or another required such service and replacement of old worn out parts.

In the spring of 1976, the system was expanded to include two deployment sites in the vicinity of Monticello, Mississippi, as shown on Figure 1. Martek brand sensors were provided by Marshall Space Flight Center under the no-cost contract for use at these locations. In February and March of 1976, anchors were deployed at two favorable locations. In the course of anticipating shipment of the necessary analyzing equipment, considerable vandalism was inflicted on the floats and antennas over a period of about six weeks. One antenna was stolen and one float was disconnected from its anchor and set adrift. The float was recovered, while the antenna is still missing. In addition, both of the antennas were damaged by fire arm vandalism.

In early April, 1976, MAWPCC and PRBDD personnel visited Marshall Space Flight Center for orientation to the new Martek equipment. Orientation included calibration and general maintenance of the sensor equipment. To date, the Martek units have provided inadequate data and frequently

fail to transmit any intelligible data. Two of the Martek units were used temporarily in the Jackson area prior to use at the Monticello locations.

A fourth data collection platform was activated near Wanilla just above Monticello, Mississippi, in early June, 1976. A Hydrolab analyzer was installed in the original float-canister DCP arrangement. Similar problems to those encountered earlier reoccurred in that seepage into the canister created problems which affected the operation of the equipment. Certain hardware equipment was replaced and greater care was taken in sealing the canisters, thus solving the problem.

The fifth data collection platform proposed for the Monticello area was never deployed due to the vandalism discussed earlier.

PROBLEMS ENCOUNTERED DURING THE PROJECT

Problems encountered during the 18 months of this project were associated with both the physical characteristics of the Pearl River and the equipment. Probably the most frequent and difficult problem to deal with was the lack of a convenient access to the buoys, coupled with erratic stages of the Pearl River. During the course of the Pearl River Data Collection System, the Pearl River fluctuated from a low of 1.11 meters (3.5 feet) on the Jackson gage to a high of approximately 11.58 meters (38 feet). During the late spring of 1975, when the river rose 7.62 meters (25 feet) within three days of flash flooding, the original anchor system (bottom anchor) was not adequate to cope with such flows and subsequently, two of the buoy units were inundated and severly damaged. Although this problem was solved by redesigning the anchor system using an overhead suspended cable, the problem of erratic stages continued to handicap the day-to-day maintenance of the system.

The original two-part DCP's required a relatively large pontoon boat for routine maintenance and instrument calibration, since the entire 204.1 kilogram (450 pound) instrument housing had to be pulled from the river. However, at the low stages experienced frequently during the first summer months, the pontoon boat was too large to navigate the river. Consequently, maintenance of the buoys was impossible as long as the river stage remained approximately 1.98 meters (6.5 feet) or less. Although the installation of the

single unit DCP's allowed easy maintenance from a small johnboat, the lack of proper launching ramps made launching and drydocking extremely difficult and laborious.

The telephone link from NSTL to the MAWPCC Data Processing Center in Jackson evidenced acceptable workability. However, the tracking by NSTL lacked consistency and predictability. On several occasions, transmission from NSTL was interrupted for as long as two weeks, either as a result of antenna repairs or other internal problems with the handling of the data at NSTL. A confidence gap immediately arose as a result of this lack of continuity of receiving the data.

Although the periodic breakdown of old and worn parts was to be expected, a skilled electronics technician was never utilized locally to recognize and remedy minor problems in the hydrolab circuitry. Additional delays of many weeks in collecting meaningful data was experienced when small elements had to be shipped off for repair or replacement.

Even though field personnel were sent to Texas to learn how to calibrate and perform maintenance of the new Martek equipment, data received from these instruments were, generally speaking, unreliable. For example, temperature during the summer months of 1976, as measured by one of the Marteks, was consistently reading 283.15 ^{o}K (10 ^{o}C) or lower, while the other Martek instruments measured more reasonable values of 298.15 - 303.15 ^{o}K (25 - 30 ^{o}C). Other Martek instruments displayed frequently unreliable data with respect to the other parameters, as indicated in

Appendix A. Initially these values were checked in the field using independent field instruments. Although calibration and maintenance were routinely maintained, the values as transmitted rarely produced reliable results.

As with all projects of this nature, vandalism was an expected problem. Although vandalism did occur occasionally, the problems resulting from this were very minor. The most serious problems occurred in the Monticello area in the spring of 1976. The extent of this vandalism has already been discussed in the section entitled "History of the Project".

One other problem which at certain times had a significant bearing on the transmission of data was the angle of transmission from the data collection platform to the satellite overhead. The Pearl River Valley is heavily wooded throughout, expecially along the bank lines. In the Jackson vicinity the banks are generally high and with the tall trees on the banks, a substantial barrier stood between a direct transmission from the antenna on the data collection platform to the satellite overhead when the satellite was at a low angle to the earth's horizon. As the stages dropped to 0.91 to 1.22 meters (3 to 4 feet), the angle obviously was more impaired and the frequency of an effective transmission was thus reduced.

EVALUATION AND CONCLUSIONS

The foregoing chapter would appear to point toward a rather negative evaluation of the Pearl River Data Collection System. Our experience with the system reflects a positive approach to this concept of remote sensing. Streams such as the Pearl River, however, present very difficult environments for a system such as this to perform to an efficiency which would justify the costs. Without accomplishing an extensive cost-effectiveness analysis, it is evident that the quality and quantity of data received does not justify the capital expenditure required for the deployment of such a system if the State of Mississippi were to proceed with such, nor the daily operation and maintenance costs which would obviously be high as a result of the physical impairments presented by the Pearl River.

The overriding problem encountered throughout the project period was that the system never was stabilized for any length of time so that applications of the data could be developed. It is our opinion that with (1) a reasonably stable hydraulic system, (2) sufficiently skilled and available manpower, and (3) access to the DCP's with a small amount of effort, a workable and reliable remote sensing program can be established. An example of such a program would be in its use on certain critical reservoirs or lakes used for water supply and/or recreation. Other uses of remote sensing equipment may be developed in the areas of

in-line monitoring of sewer systems and in-plant monitoring of major wastewater treatment plant effluents.

ABSTRACT

The objective of this project was to demonstrate and evaluate the reliability of employing NASA developed remote sensing DCP's for the monitoring of water quality in the Pearl River.

Three DCP's were employed in the Jackson, Mississippi, area from April, 1975 to October, 1976 and a fourth in the Monticello, Mississippi, area from June, 1976 to October, 1976, with analytical equipment capable of measuring pH, dissolved oxygen, temperature, and conductivity.

Throughout the project period problems relating to the physical characteristics of the Pearl River hampered the acquisition of continuous, reliable data. Specifically, rapid changes in river stage and limited access to the buoys caused equipment damage and routine maintenance problems. In addition, long delays were experienced when broken or worn parts had to be shipped back to Texas for repair or replacement. Vandalism was more of a problem in the Monticello area than the Jackson area.

In spite of the maintenance problems encountered with the system, the three DCP's in the Jackson area provided efficient and accurate data during the fall of 1975 and early spring of 1976. However, by fall of 1976, it was evident that the quality and quantity of the data did not justify the capital expenses or daily operation and maintenance costs which would obviously be high as a result of the physical impairments presented by the Pearl River.

It is the author's opinion that the DCP's can be used to establish a reliable remote sensing program for water quality monitoring where there exists (1) a reasonably stable hydraulic system, (2) sufficiently skilled and available manpower, and (3) access to the DCP's with a small amount of effort.

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APPENDIX A

WATER QUALITY DATA COLLECTED DURING THE PEARL RIVER DATA COLLECTION SYSTEM

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DATE	TIME	DCP	DO	PH	COND	TEMP	I
042375	160855	6224	08.47	06.59	037.65	24.22	F
042475	152007	6224	08.24	06.78	035.69	22.65	F
042475	152600	6224	08.24	06.82	036.86	22.45	F
042575	150305	6224	09.41	06.90	037.65	19.90	F
042575	150601	6224	09.41	06.86	036.86	19.90	F
042875	142101	6224	08.55	06.90	035.69	18.14	F
042875	142357	6224	08.63	06.90	037.65	18.53	F
042975	152348	6224	08.55	06.90	035.69	18.33	F
043075	152824	6224	08.16	07.06	035.69	20.10	F
043075	153120	6224	08.16	07.06	035.69	20.10	F
050175	162342	6224	08.39	07.10	041.57	22.84	F
050975	162052	6060	09.33	07.37	041.57	39.51	F
050975	162404	6060	09.18	07.33	040.78	39.51	F
051275	163822	6060	09.18	07.57	037.65	38.53	F
051375	164331	6060	09.73	07.61	018.82	36.57	F
051375	164639	6060	09.65	07.61	018.82	36.76	F
051375	164948	6060	12.24	07.33	018.82	36.57	F
051475	151021	6060	09.41	07.69	028.24	36.96	F
051475	151330	6060	09.33	07.73	028.63	36.96	F
051575	151554	6224	11.84	07.41	022.75	36.96	F
051675	151921	6224	10.27	07.57	022.35	37.35	F
051975	153453	6224	10.51	07.53	020.78	35.98	F
051975	154039	6224	10.59	07.53	023.14	35.59	F
052075	154244	6224	11.14	07.45	025.10	35.39	F
052075	154537	6224	11.06	07.45	025.10	35.39	F
052175	155146	6224	13.65	07.49	027.45	35.20	F
052275	155540	6120	07.53	05.29	087.84	27.94	F
052375	155808	6120	06.67	05.02	099.22	27.35	F
052375	160112	6120	06.75	05.06	098.43	27.35	F
052775	144204	6120	05.80	06.00	096.47	28.33	F
052775	162335	6120	05.96	05.92	092.94	28.92	F
052875	144552	6120	05.33	06.08	097.65	29.71	F
052875	163001	6120	05.18	06.00	095.29	29.12	F
052975	145201	6120	05.02	06.08	100.00	29.71	F
052975	145505	6120	04.47	05.96	099.22	29.51	F
061975	165039	6323	01.80	06.86	100.00	27.16	F
061975	165332	6323	01.73	06.86	100.00	27.35	F
061975	165625	6323	01.61	06.90	100.00	27.16	F
062075	151615	6323	03.14	07.02	100.00	23.24	F
062075	151331	6346	06.82	07.57	060.00	25.39	F
062075	151622	6346	06.82	07.49	059.61	25.39	F
062475	153803	6323	02.39	07.33	100.00	25.20	F
062475	153605	6346	01.14	07.33	096.08	28.14	F
062475	153854	6346	01.18	07.37	095.69	28.14	F
062475	154144	6346	01.14	07.33	096.08	28.14	F
062575	154049	6323	03.02	07.57	100.00	24.80	F
062575	154703	6346	00.86	07.96	100.00	27.94	F
063075	143000	6346	01.22	07.88	100.00	27.94	F
063075	143250	6346	01.25	07.88	100.00	27.94	F
070175	143701	6346	01.25	07.88	100.00	27.55	F
070175	161857	6346	01.22	07.84	100.00	28.33	F
070175	162147	6346	01.22	07.84	100.00	28.33	F
070275	162108	6346	01.22	07.73	100.00	28.73	F
070275	162357	6346	01.22	07.69	100.00	28.73	F
070275	162646	6346	01.22	07.69	100.00	28.73	F
070375	144949	6346	00.78	07.14	100.00	29.31	F
070375	162833	6346	04.82	07.02	100.00	29.31	F
070775	150933	6346	01.73	06.75	100.00	28.33	F
070775	151222	6346	01.80	06.75	100.00	28.53	F
070775	165358	6346	01.41	06.82	100.00	29.31	F
070875	165614	6346	00.82	07.25	100.00	27.55	F
070875	165904	6346	00.90	07.33	100.00	27.55	F
070975	152223	6346	02.55	07.53	100.00	28.53	F
071175	153049	6323	06.82	06.55	057.65	28.14	F
071175	153343	6323	06.82	06.59	057.65	28.14	F
071175	153045	6346	06.31	07.61	086.27	27.94	F
071475	154858	6323	06.47	06.51	065.10	28.14	F
071475	155151	6323	06.51	06.39	064.71	28.14	F
071475	154759	6346	05.61	08.55	082.35	26.96	F
071675	160103	6346	02.24	08.71	100.00	28.33	F
071775	160349	6323	01.84	06.71	100.00	28.73	F
071775	160642	6323	01.84	06.71	100.00	28.73	F
071775	160552	6346	00.82	09.02	100.00	27.35	F
071875	142712	6346	00.90	07.57	100.00	27.75	F
071875	143001	6346	00.90	07.57	100.00	27.75	F
071875	160944	6323	01.18	07.49	100.00	29.31	F
071875	161237	6323	01.14	07.49	100.00	29.31	F
071875	160849	6346	00.86	07.57	100.00	28.53	F

071875	161138	6346	00.86	07.57	100.00	28.53	E
072175	163058	6346	04.47	07.22	100.00	29.51	E
072275	145125	6346	01.06	07.10	100.00	27.94	E
072275	145414	6346	01.10	07.10	100.00	27.75	E
072375	145725	6120	06.55	05.88	060.00	29.12	E
072475	150230	6156	06.78	07.02	095.69		E
072475	150543	6120	05.96	05.84	063.53	28.92	E
072875	152538	6120	06.16	04.31	063.53	29.90	E
072875	152525	6156	06.16	07.02	094.12	27.75	E
072875	152615	6323	06.27	06.86	081.18	28.92	E
072975		6120	06.67	06.08	062.35	29.90	E
072975	153107	6156	07.33	06.86	094.51	27.75	E
072975	153134	6323	06.27	06.96	085.10	28.92	E
073075	153824	6120	06.71	06.12	062.35	29.51	E
073075	153928	6156	07.22	07.02	092.16	29.51	E
073075	153559	6323	06.75	06.98	069.41	28.53	E
073175	154447	6120	07.65	06.08	061.18	29.51	E
073175	154430	6156	07.18	06.36	096.08	27.94	E
073175	154548	6323	06.51	07.02	065.49	28.92	E
080175	154849	6120	08.08	06.04	063.92	28.73	E
080175	155057	6323	06.24	06.94	072.55	27.16	E
080475	161012	6156	07.84	07.02	081.96	15.59	E
080475	160735	6323	01.57	03.73	014.12	11.08	E
081275	115648	6323	06.24	06.24	060.39	26.76	E
081375	161505	6120	01.29	03.18	018.82	01.27	E
081375	161736	6323	06.71	06.12	054.90	27.55	E
081375	165501	6323	06.86	05.76	057.25	27.35	E
081375	165754	6323	06.86	02.00	057.25	27.16	E
081475	151851	6323	07.14	06.08	053.33	27.55	E
081575	152303	6323	06.78	06.08	056.86	27.94	E
081575	152559	6323	06.75	06.08	056.47	27.94	E
081875	153909	6323	06.63	06.12	069.41	26.18	E
081875	154207	6323	06.71	06.12	069.80	25.78	E
081975	154625	6323	06.47	06.39	067.06	26.76	E
081975	154922	6323	06.43	06.39	067.06	26.76	E
082075	155332	6323	05.96	08.35	011.37	45.00	E
082175	160005	6323	05.92	08.20	010.98	45.00	E
082175	160302	6323	05.80	08.12	009.80	45.00	E
082275	160215	6323	06.08	08.27	010.98	45.00	E
082975	150117	6323	05.37	06.78	080.39	29.51	E
082975	164511	6323	05.57	06.82	081.18	28.92	E
091275	161910	6323	01.84	04.12	100.00	31.86	E
091275	162210	6323	01.84	04.20	100.00	27.15	E
091275	162510	6323	01.80	04.20	100.00	26.76	E
091575		6323	02.55	05.61	100.00	25.59	E
091975	151858	6323	02.98	04.94	018.82	25.59	E
091975	152201	6323	02.86	05.02	018.04	25.20	E
100675	101139	6323	10.00	04.20	011.37	20.29	E
100875	092122	6323	10.00	07.41	079.22	20.88	E
100875	092427	6323	10.00	07.49	079.22	21.67	E
112675	163452	6060	04.71	06.86	078.04	10.49	E
112675	164145	6060	04.71	06.86	078.43	10.49	E
112675	163639	6164	05.10	06.04	071.76	10.69	E
112675	164314	6164	05.06	05.92	071.37	10.49	E
120875	160315	6164	04.86	06.35	076.08	11.47	E
120975	160812	6164	05.29	06.16	069.02	11.08	E
121075	161506	6164	05.33	07.29	067.45	10.69	E
121075	161828	6164	05.37	06.86	066.67	10.49	E
121575	145958	6164	10.28	06.63	066.27	12.45	E
121575	145950	6164	10.28	06.59	066.27	12.45	E
121575		6060	09.34	06.71	055.29	13.04	E
121675	150528	6164	09.10	06.55	100.00	12.84	E
121675	150845	6164	09.10	06.55	100.00	12.84	E
121675	151202	6164	09.10	06.71	100.00	12.65	E
121675	165032	6164	09.26	06.71	100.00	12.25	E
121675	165349	6164	09.26	06.71	100.00	12.45	E
121775	150443	6060	08.32	05.65	099.22	11.67	E
121775	150839	6164	09.56	06.63	100.00	12.06	E
121775	151157	6164	09.56	06.51	100.00	11.47	E
121875	152122	6060	10.28	02.00	014.12	04.22	E
121875	151540	6164	10.50	06.67	077.25	10.29	E
121875	151905	6164	10.44	06.59	076.47	10.49	E
121875	152230	6164	10.44	06.51	075.69	10.10	E
121975	152157	6060	10.66	02.00	046.67	07.55	E
121975	152537	6060	10.66	02.00	049.41	07.35	E
121975	152108	6164	11.46	07.29	069.02	07.55	E
121975	152436	6164	11.52	07.37	069.80	07.55	E
122675	160030	6060	09.26	02.00	099.61	06.76	E
122675	160729	6060	09.42	02.00	100.00	06.76	E
122675	160357	6164	10.50	07.33	100.00	06.76	E
123075	162758	6060	10.98	04.31	060.78	08.14	E

123075	163123	6060	10.74	04.24	061.18	08.14	F
123075	162804	6164	12.00	07.02	067.45	07.55	F
123175	163310	6060	10.50	04.00	060.00	08.14	F
123175	163637	6060	10.44	03.92	060.00	08.14	F
010276	150056	6060	11.30	05.33	059.61	07.75	F
010276	150420	6060	11.06	05.45	063.14	07.94	F
010276	145832	6164	11.84	06.78	064.31	08.14	F
010276	150147	6164	11.84	06.78	064.31	07.75	F
010576	151951	6060	11.38	02.00	063.53	06.76	F
010576	152111	6060	11.84	06.67	070.98	05.98	F
010676	170639	6060	11.22	02.00	061.96	05.98	F
010676	170737	6164	11.84	07.02	069.41	06.57	F
010676	152113	6164	11.84	06.86	067.45	05.98	F
010676	152436	6164	11.68	06.96	067.45	05.98	F
010776	152337	6060	11.22	02.00	063.14	07.35	F
010776	152702	6060	11.14	02.00	064.71	07.35	F
010776	152346	6164	11.76	07.06	067.45	06.96	F
010776	152701	6164	11.60	07.06	067.84	06.96	F
010876	153523	6060	11.30	02.00	062.35	05.78	F
010876	153353	6164	10.98	06.90	070.98	05.98	F
010876	153702	6164	11.92	06.71	068.24	05.20	F
010976	153650	6164	12.54	06.82	071.76	04.41	F
010976	154018	6164	12.62	06.71	070.20	03.63	F
010976	154347	6164	12.54	06.75	071.37	04.02	F
011276	155932	6164	12.48	07.57	071.76	05.59	F
011576	161417	6060	10.74	02.00	069.02	06.76	F
011576	161152	6164	11.38	07.61	073.73	06.76	F
011576	161515	6164	11.46	07.96	074.90	07.16	F
011576	161838	6164	11.30	07.76	074.51	06.96	F
011676	161740	6156	10.00	05.88	058.16	06.57	F
011676	162054	6156	10.00	06.08	052.16	06.57	F
011676	162409	6156	10.00	06.39	052.16	06.96	F
011676	161711	6164	11.76	08.43	069.02	06.76	F
011676	162028	6164	11.76	08.04	069.41	06.76	F
011676	162345	6164	11.68	08.24	069.80	06.57	F
011976	145615	6164	12.32	05.14	067.06	05.20	F
012076	145833	6060	11.60	04.51	067.84	06.57	F
012076	150202	6060	11.60	04.43	067.45	06.18	F
012076	150059	6156	10.00	06.12	054.90	06.18	F
012076	150415	6156	10.00	05.92	054.51	06.37	F
012276	151431	6060	11.30	04.43	070.20	05.98	F
012276	150940	6156	10.00	06.04	055.69	06.18	F
012276	151300	6156	10.00	05.92	054.51	06.57	F
012176	150516	6060	12.00	04.20	057.25	05.59	F
012176	150853	6060	11.76	04.08	058.82	05.59	F
012176	164951	6060	11.92	03.96	056.86	05.20	F
012176	165325	6060	12.08	04.16	059.22	05.59	F
012176	150623	6156	10.00	06.47	051.37	06.18	F
012176	150945	6156	10.00	06.47	050.98	08.33	F
012176	164612	6156	10.00	06.39	054.51	06.18	F
012176	164928	6156	10.00	06.39	054.12	07.55	F
012176	150323	6164	12.08	05.02	065.10	04.80	F
012176	164904	6164	12.08	05.25	067.06	05.20	F
012176	165224	6164	12.08	05.33	067.45	05.59	F
012276	165439	6060	11.38	04.63	069.41	05.78	F
012276	165812	6060	11.46	04.75	070.59	05.98	F
012276	165142	6156	10.00	05.88	055.29	06.57	F
012276	165456	6156	10.00	05.88	055.29	06.57	F
012276	165809	6156	10.00	05.88	056.47	06.57	F
012276	165305	6164	11.92	05.80	073.33	05.39	F
012276	165624	6164	12.00	05.76	072.94	05.20	F
012376	151547	6060	11.38	05.76	056.08	06.18	F
012376	151921	6060	11.30	05.76	055.29	05.98	F
012376	151425	6156	10.00	07.06	050.59	06.37	F
012376	152104	6156	10.00	07.45	050.20	06.37	F
012376	152101	6164	12.16	05.96	067.45	05.98	F
012376	170529	6060	11.30	05.88	059.61	06.37	F
012376	165915	6156	10.00	07.45	052.55	06.37	F
012376	165804	6164	12.24	05.96	067.06	05.98	F
012376	170434	6164	11.84	05.96	068.24	05.98	F
012676	153645	6060	09.42	08.39	080.39	10.69	F
012776	172237	6164	11.68	05.65	091.76	07.55	F
012776	172552	6164	11.84	05.61	090.98	07.16	F
012776	153833	6060	11.06	10.24	070.98	07.75	F
012776	154206	6060	11.06	10.24	070.98	07.94	F
012776	154322	6164	11.60	05.65	097.25	07.35	F
012876	154758	6060	11.52	11.02	063.14	06.76	F
012876	154456	6164	12.24	05.41	074.51	06.76	F
012876	154821	6164	12.24	05.25	072.94	05.98	F
012976	154855	6060	11.60	11.53	061.96	06.76	F
012976	155228	6060	11.76	11.49	060.78	06.96	F

012976	155018	6156	10.00	07.53	049.41	07.16	F
012976	155310	6164	12.48	05.06	067.06	06.18	F
013076	155846	6060	11.68	12.00	060.00	06.96	F
013076	155328	6156	10.00	07.57	051.37	07.55	F
013076	155958	6156	10.00	07.10	051.76	08.33	F
013076	155631	6164	12.40	05.14	067.06	06.37	F
020276	161445	6060	10.98	12.00	067.84	07.35	F
020276	161817	6060	10.98	12.00	068.63	07.35	F
020276	161245	6156	10.00	08.00	050.59	08.33	F
020376	143623	6060	10.90	12.00	063.92	07.75	F
020376	143956	6060	10.90	12.00	063.92	07.75	F
020376	143647	6156	10.00	07.69	048.63	09.12	F
020376	143830	6164	11.38	05.22	072.16	07.35	F
020376	161911	6060	10.90	12.00	064.31	07.75	F
020376	162145	6156	10.00	07.18	050.20	08.33	F
020376	162459	6156	10.00	07.33	050.20	08.33	F
020376	162229	6164	11.52	05.25	070.98	07.35	F
020376	162546	6164	11.52	05.33	071.37	07.55	F
020476	144122	6060	11.06	12.00	063.53	08.33	F
020476	144448	6060	11.14	12.00	063.53	08.33	F
020476	144210	6156	10.00	07.69	050.59	08.33	F
020476	144011	6164	11.60	05.37	067.84	08.14	F
020476	144328	6164	11.52	05.25	068.63	07.75	F
020476	144645	6164	11.52	05.41	069.02	07.94	F
020476	162332	6060	11.14	12.00	064.31	08.33	F
020476	162503	6156	10.00	07.53	051.37	08.73	F
020476	163127	6156	10.00	07.80	050.98	09.12	F
020476	162434	6164	11.46	05.45	069.02	08.14	F
020476	163102	6164	11.38	05.41	069.41	08.14	F
020576	144727	6060	11.14	09.84	063.14	08.92	F
020576	145047	6060	11.14	09.22	063.14	08.92	F
020576	144821	6156	10.00	07.41	051.37	08.53	F
020576	145131	6156	10.00	07.69	052.16	10.69	F
020576	144517	6164	11.60	05.57	068.63	08.53	F
020576	144828	6164	11.68	05.57	067.45	08.53	F
020576	145140	6164	11.68	05.41	067.84	08.33	F
020676	145223	6156	10.00	07.65	050.59	09.31	F
020676	145424	6164	11.38	05.61	069.02	09.12	F
020676	145741	6164	11.38	05.65	069.02	09.12	F
020676	163711	6060	10.82	09.06	058.43	09.31	F
020676	163954	6156	10.00	07.33	049.80	09.90	F
020676	164310	6156	10.00	07.33	050.20	09.31	F
020676	163626	6164	11.46	05.53	068.63	08.92	F
020676	163944	6164	11.38	05.49	068.63	08.92	F
020676	164301	6164	11.46	05.49	068.63	08.92	F
020976	151512	6060	09.02	02.00	074.12	07.55	F
020976	151416	6156	10.00	07.45	049.02	08.92	F
021076	151533	6060	09.88	09.33	065.10	09.51	F
021076	151857	6060	10.04	09.33	064.71	09.31	F
021076	151731	6156	10.00	11.10	049.80	08.92	F
021076	152043	6156	10.00	11.33	051.76	08.92	F
021076	151908	6164	10.82	06.35	073.33	08.73	F
021176	152205	6060	10.20	09.61	066.27	09.71	F
021176	152528	6060	10.28	09.57	066.67	09.57	F
021176	152138	6164	10.90	06.31	072.16	09.31	F
021176	152453	6164	10.58	06.39	073.73	09.31	F
021176	170740	6164	10.98	06.39	072.94	09.12	F
021376	153515	6156	10.00	03.14	049.80	10.29	F
021376	153553	6164	10.90	06.59	068.63	09.51	F
021776	160015	6164	09.72	11.92	007.06	15.98	F
021976	142627	6060	08.00	06.16	097.25	14.41	F
021976	161034	6060	08.00	05.88	100.00	14.80	F
021976	161359	6060	08.00	05.92	100.00	14.61	F
021976	161000	6164	09.34	06.12	041.18	14.41	F
021976	161315	6164	09.26	06.20	041.18	14.61	F
022076	161206	6060	08.16	05.76	084.71	14.61	F
022076	161528	6060	08.16	05.73	083.92	14.41	F
022076	161549	6164	09.42	05.96	029.41	14.02	F
022076	161902	6164	09.42	06.04	029.80	14.41	F
022376	163411	6060	09.02	05.49	075.29	12.45	F
022376	163229	6164	10.74	05.45	021.57	12.25	F
022376	163544	6164	10.74	05.49	022.35	12.65	F
022676	150358	6060	08.86	02.00	068.24	13.63	F
022676	150721	6060	08.94	02.00	067.84	13.63	F
022676	151044	6060	08.94	02.00	068.24	13.82	F
022676	150519	6164	10.28	05.10	022.35	13.82	F
022676	165038	6060	09.02	02.00	070.20	13.82	F
022676	164640	6164	10.28	05.10	022.75	13.82	F
022676	165250	6164	10.28	05.18	022.35	13.63	F
022776	150948	6060	01.88	02.00	065.88	13.82	F
022776	151315	6060	01.80	02.00	068.63	13.82	F

022776	151059	6164	09.80	05.14	022.35	14.02	F
022776	151415	6164	09.88	05.18	023.14	14.22	F
030476	154158	6060	09.72	03.73	070.59	12.45	F
030476	154528	6164	09.18	06.04	028.24	16.37	F
030876	160637	6060	10.04	07.14	050.20	20.29	F
030876	160648	6164	09.80	06.20	023.14	15.59	F
033176	145500	6164	01.56	06.51	015.69	17.55	F
033176	145812	6164	01.56	06.55	016.47	17.55	F
033176	163559	6156	20.00	06.86	001.57	13.24	F
040176	164035	6164	01.50	06.12	018.43	17.35	F
040176	165934	6164	01.50	06.04	016.86	16.96	F
040276	164954	6164	01.50	06.08	017.25	17.16	F
040276	150218	6156	20.00	06.67	001.18	12.84	F
040276	150835	6156	20.00	06.67	001.18	12.84	F
040276	150330	6164	01.50	06.08	016.86	17.16	F
040576	170657	6164	01.50	05.92	016.47	18.14	F
040676	153113	6156	05.34	06.55	001.18	10.88	F
040676	171148	6156	05.34	06.55	001.18	10.88	F
040776	153008	6156	04.54	06.55	001.18	11.27	F
040776	153313	6156	04.54	06.55	001.18	11.27	F
040776	153618	6156	02.62	06.59	001.18	11.27	F
040776	153047	6164	15.43	05.49	016.47	18.73	F
040776	171306	6156	04.54	06.59	001.18	11.47	F
040776	171605	6156	04.70	06.59	001.18	11.47	F
040776	171727	6323	18.50	07.06	045.10	17.94	F
040876	154039	6156	03.46	06.63	001.18	12.06	F
040876	153945	6323	18.98	06.59	043.14	18.53	F
040876	171809	6156	03.38	06.67	001.18	12.06	F
040976	154215	6156	04.70	06.67	001.18	11.27	F
040976	154521	6156	04.70	06.71	001.18	11.27	F
040976	154625	6323	19.22	07.02	036.47	18.33	F
040976	154130	6164	15.92	06.16	013.33	19.31	F
040976	154749	6164	15.84	06.20	012.94	19.51	F
041276	155938	6156	09.02	06.71	001.18	11.47	F
041276	160239	6156	09.02	06.71	001.18	11.67	F
041276	155817	6323	10.50	06.94	044.31	17.94	F
041276	160116	6323	10.50	06.86	043.53	18.33	F
041276	160051	6164	15.22	06.31	018.04	18.92	F
041376	160354	6156	08.94	06.71	001.18	12.25	F
041376	160658	6156	08.94	06.71	001.18	12.25	F
041376	160609	6323	18.50	06.78	046.27	18.53	F
041476	160921	6156	00.00	02.00	000.00	00.00	F
041476	161224	6156	00.00	02.00	000.00	00.00	F
041976	164555	6156	00.00	02.00	000.00	00.00	F
041976	163747	6323	16.48	06.63	069.02	21.86	F
041976	164334	6323	16.16	06.51	069.02	20.69	F
042076	164442	6156	00.00	02.00	000.00	00.00	F
042076	165024	6323	14.90	05.92	065.49	21.27	F
042076	164651	6164	15.76	05.76	026.67	21.67	F
042076	164952	6164	15.68	05.88	026.67	21.47	F
042176	150755	6156	08.00	06.75	001.18	17.94	F
042176	151100	6156	08.08	06.71	001.18	18.14	F
042176	150726	6323	14.74	06.55	058.43	21.08	F
042176	151029	6323	13.72	06.59	058.82	20.88	F
042176	151158	6164	13.88	06.90	044.71	20.69	F
042276	151619	6156	08.00	06.75	001.18	18.33	F
042276	151533	6323	14.28	06.71	070.59	21.47	F
042276	151513	6164	13.96	06.94	036.86	20.69	F
042276	151822	6164	14.50	06.90	036.86	20.69	F
042376	152001	6156	07.76	06.63	001.96	20.29	F
042376	152303	6156	08.00	06.63	078.82	20.69	F
042376	152254	6323	14.12	06.75	071.37	22.25	F
042776	154132	6156	08.70	06.78	001.96	19.31	F
042776	154126	6323	16.00	07.29	078.43	20.10	F
042776	154430	6323	15.92	07.49	078.82	20.10	F
042776	154251	6164	16.24	07.06	030.59	20.49	F
042776	154601	6164	16.00	06.98	030.98	20.69	F
042676	153734	6156	08.40	06.75	001.96	19.31	F
042676	153649	6323	15.06	07.33	092.16	21.67	F
042676	153649	6164	14.44	06.94	032.55	20.69	F
042676	154001	6164	13.50	07.02	033.33	20.69	F
042876	155017	6156	08.24	06.78	001.96	19.71	F
042876	154740	6164	08.62	06.08	021.57	20.69	F
042876	155045	6164	16.54	06.04	021.57	20.69	F
042976	155309	6156	09.42	06.90	001.96	17.55	F
042976	155613	6156	09.34	06.90	001.96	17.55	F
042976	155506	6323	17.56	02.00	057.25	21.67	F
050376	161402	6156	00.31	03.53	000.39	32.25	F
050476	144231	6156	01.96	03.96	019.22	04.61	F
050476	162744	6156	02.00	04.00	019.61	04.80	F
051076	151438	6156	04.04	06.86	001.57	16.76	F

051076	151742	6156	04.04	06.86	001.57	16.76	F
051076	151608	6323	07.29	02.00	065.10	21.27	F
051076	151438	6164	07.88	06.75	044.31	21.08	F
051076	151745	6164	07.88	06.75	044.31	21.08	F
051176	151806	6323	09.37	07.25	055.29	19.90	F
052476	145226	6156	03.61	06.98	000.39	20.69	F
052476	145529	6156	03.65	06.98	000.39	20.69	F
052476	145256	6323	08.12	08.31	063.14	23.43	F
052476	163502	6156	03.57	06.98	000.39	20.69	F
052476	163802	6156	03.57	06.98	000.39	20.69	F
052476	163416	6323	08.12	08.43	067.06	23.43	F
051276	152429	6156	04.08	06.82	001.57	17.16	F
051276	153028	6156	04.04	06.78	001.57	17.16	F
051276	152612	6164	08.55	06.82	021.18	21.47	F
051276	152913	6164	08.63	06.78	021.18	21.47	F
051376	153004	6156	04.00	06.82	001.57	16.76	F
051376	153307	6156	04.04	06.82	001.57	16.76	F
051376	153609	6156	04.00	11.96	000.39	16.76	F
051376	153120	6323	09.18	02.00	059.61	21.86	F
051376	153018	6164	08.27	07.10	024.71	21.47	F
051376	153322	6164	08.35	07.06	025.10	21.67	F
051776	160002	6156	04.00	06.94	001.96	17.94	F
051776	155252	6323	09.33	02.00	045.49	20.69	F
051776	155548	6323	09.33	02.00	047.06	21.67	F
051776	160029	6164	08.75	06.71	018.82	21.27	F
051876	155800	6156	04.04	06.82	001.96	17.75	F
051876	160704	6156	04.00	06.82	001.96	17.75	F
051876	155805	6323	09.33	08.31	052.55	21.27	F
051876	160405	6323	09.22	08.55	051.37	21.27	F
051876	160405	6323	09.25	08.51	050.98	21.08	F
051876	141954	6164	08.78	06.86	019.22	21.67	F
052076	161152	6156	04.43	07.10	000.39	19.71	F
052076	161452	6156	04.47	07.10	000.39	19.71	F
052076	161751	6156	04.43	07.10	000.39	19.71	F
052076	161550	6323	09.45	02.00	050.20	21.27	F
052076	161407	6164	00.51	06.63	019.22	21.27	F
052076	161705	6164	00.51	06.63	018.82	21.27	F
052076	142839	6156	04.51	07.02	000.39	19.51	F
052076	143145	6156	04.51	07.02	000.39	19.31	F
052076	143028	6164	00.51	06.59	018.43	21.47	F
052176	143444	6156	04.39	07.02	000.39	19.51	F
052176	161820	6156	04.27	07.02	000.39	19.71	F
052176	162146	6323	09.37	08.63	052.55	21.27	F
052576	145845	6323	07.96	08.39	073.73	22.45	F
052576	163850	6156	03.41	07.02	000.39	21.86	F
052576	164152	6323	08.16	08.59	079.22	23.04	F
052676	150123	6323	07.53	08.43	070.59	23.43	F
052676	150728	6323	07.25	08.43	070.59	23.43	F
052676	150334	6164	00.63	06.63	036.47	23.63	F
052676	164753	6156	04.75	06.78	000.39	20.88	F
052676	164640	6323	07.80	08.51	072.94	23.24	F
052676	164501	6164	00.63	06.63	037.25	23.43	F
052676	164804	6164	00.63	06.63	037.65	23.43	F
052776	150835	6156	04.75	06.82	000.39	20.49	F
052776	151141	6156	04.75	06.82	000.39	20.49	F
052776	150938	6323	07.80	08.43	068.63	21.86	F
052776	151243	6323	07.80	08.47	069.02	21.86	F
052776	165320	6156	04.71	06.82	000.39	20.69	F
052876	151844	6323	07.80	08.75	068.24	20.29	F
060176	153529	6156	04.71	06.78	000.39	19.90	F
060176	153832	6156	04.67	06.78	000.39	19.90	F
060176	153748	6323	08.35	08.55	065.88	22.06	F
060276	154236	6323	09.02	07.10	068.24	22.06	F
060276	154153	6164	00.35	06.39	049.80	09.71	F
060376	154851	6156	03.84	05.29	000.39	35.00	F
060476	155230	6156	00.00	03.33	000.00	25.00	F
060476	155529	6156	00.00	03.33	000.00	25.00	F
060476	155402	6323	09.06	06.94	071.76	24.02	F
060476	155657	6323	08.94	06.82	071.37	23.24	F
060476	155426	6164	00.31	06.35	053.33	09.12	F
060876	143406	6156	01.92	03.92	019.22	04.61	F
060876	143445	6323	07.53	06.86	085.10	24.02	F
060876	143627	6164	00.39	06.43	055.69	07.55	F
060976	144105	6323	07.80	07.02	096.86	24.61	F
060976	143810	6164	00.04	06.67	054.12	11.86	F
060976	144115	6164	00.04	06.67	054.12	11.67	F
061076	144428	6323	06.78	07.14	100.00	25.98	F
061076	144728	6323	07.06	07.14	100.00	25.98	F
061076	144408	6164	00.55	06.75	056.08	10.29	F
061076	144712	6164	00.55	06.75	056.08	10.29	F
061176	145058	6323	05.92	07.22	100.00	25.39	F

061176	145357	6323	05.96	07.22	098.43	28.92	F
061176	145420	6164	00.59	06.75	056.86	10.10	F
061476	150829	6164	00.86	06.71	060.78	07.75	F
061476	151130	6164	00.86	06.71	060.78	07.75	F
061576	170125	6323	03.65	07.49	100.00	27.55	F
061576	165534	6164	00.94	06.63	061.96	08.92	F
061676	152142	6323	02.75	07.10	100.00	27.55	F
061676	152232	6164	00.82	07.35	061.57	07.35	F
062176	155218	6323	09.02	07.49	067.06	25.78	F
062176	155513	6323	09.41	07.49	067.06	25.59	F
062876	144843	6164	00.31	06.47	063.14	10.29	F
062876	162717	6164	00.31	06.43	063.53	10.49	F
062876	163013	6164	00.31	06.43	063.53	10.49	F
063076	163718	6323	06.86	07.18	088.24	26.76	F
063076	164014	6323	07.18	07.25	088.63	26.57	F
063076	164309	6323	07.14	07.25	089.02	27.16	F
063076	164011	6164	00.31	06.39	065.10	10.29	F
063076	164311	6164	00.31	06.39	065.10	10.29	F
070176	150313	6323	06.82	06.90	094.51	25.39	F
070176	150502	6164	00.35	06.35	059.22	09.31	F
070176	164512	6164	00.35	06.51	058.43	09.71	F
070176	164811	6164	00.35	06.47	058.43	09.71	F
070276	164815	6323	06.78	06.90	082.75	24.51	F
070976	154837	6323	07.57	02.71	069.80	27.16	F
070976	154933	6164	00.27	06.78	063.14	12.45	F
070676	171352	6164	00.27	06.75	059.22	13.63	F
071276	160506	6164	00.59	06.78	065.10	08.73	F
071376	142753	6164	00.63	06.78	066.27	07.16	F
071476	161938	6323	05.92	07.69	020.00	29.51	F
071476	161927	6164	00.39	06.94	100.00	10.49	F
071576	162115	6323	05.69	07.69	020.00	27.16	F
071576	162405	6323	05.57	07.61	020.00	27.76	F
071676	144400	6323	03.14	07.22	019.61	26.76	F
071676	144513	6164	00.39	06.86	100.00	08.14	F
071976	164652	6323	01.88	07.76	028.24	29.51	F
072276	151917	6323	03.84	07.29	024.31	28.53	F
072276	152215	6323	03.84	07.33	025.10	28.53	F
072976	155800	6323	03.57	07.37	021.18	29.31	F
080276	162223	6323	05.45	09.61	012.49	28.33	F
080376	162754	6164	00.27	06.39	067.06	04.41	F
080376	162740	6323	06.00	10.47	010.20	27.35	F
080376	163035	6323	05.96	10.51	010.20	27.35	F
080976	151918	6060	06.08	07.45	040.00	27.75	F
081076	170815	6060	06.39	07.96	039.22	26.96	F
081076	170632	6323	08.51	12.00	091.76	27.75	F
081076	152254	6323	07.73	11.73	083.14	27.94	F
080976	170209	6060	05.96	07.53	040.39	27.94	F
080976	170111	6156	00.00	02.00	000.00	-5.00	F
080976	170410	6156	00.00	02.00	000.00	-5.00	F
081176	153055	6323	07.45	12.00	100.00	27.75	F
081176	171154	6060	07.49	06.43	100.00	26.96	F
081276	153644	6060	07.14	06.98	100.00	27.75	F
081276	153423	6156	00.00	02.00	000.00	-5.00	F
081276	153724	6156	00.00	02.00	000.00	-5.00	F
081276	153513	6323	06.35	10.35	100.00	28.33	F
081376	154221	6060	06.51	07.18	100.00	28.53	F
081376	154126	6156	00.00	02.00	000.00	-5.00	F
081676	155823	6323	02.08	02.00	100.00	29.31	F
081776	160734	6060	05.80	07.49	100.00	29.90	F
081776	142038	6156	00.00	02.00	000.00	-5.00	F
090876	172835	6060	05.37	09.53	000.00	-5.00	F
090876	173000	6164	00.63	06.39	059.61	26.37	F
090976	172306	6060	05.96	07.45	000.78	-5.00	F
090976	172356	6323	07.88	07.80	090.59	27.94	F
091076	173834	6060	05.73	07.92	000.00	-5.00	F
091076	174143	6060	05.69	07.88	000.00	-5.00	F
091076	174126	6323	07.76	10.35	093.33	26.18	F
091076	173656	6164	00.75	06.75	060.00	42.06	F
091676	153124	6323	06.51	10.04	100.00	25.39	F
092076	160733	6060	04.59	06.43	006.27	-5.00	F
092076	160626	6323	03.69	07.33	100.00	25.59	F
092776	163508	6060	05.10	07.14	013.73	-5.00	F
092976	174521	6323	01.80	07.33	100.00	24.61	F
100176	151339	6060	04.51	07.33	015.69	-5.00	F
100476	152821	6323	04.00	07.33	100.00	23.43	F

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APPENDIX B

PEARL RIVER DATA COLLECTION SYSTEM
PROJECT SYSTEMS
DOCUMENT

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PEARL RIVER

DATA COLLECTION SYSTEM

APPLICATIONS PROJECT

PROJECT SYSTEMS

DOCUMENT

January 10, 1975

Prepared
By

National Aeronautics and Space Administration

National Space Technology Laboratories

Bay St. Louis, Mississippi 39520

CONCURRENCE:

NASA/NSTL Henry F. Autrey

NASA/MSFC James T. Powell

STATE OF MISSISSIPPI Ben Ward Jr.

Mississippi Air and Water Pollution Control Commission

Pearl River Basin Development District

PEARL RIVER DATA COLLECTION SYSTEM APPLICATIONS PROJECT

1.0 OBJECTIVE

The objective of this project is to demonstrate the application of NASA developed technology in satellite relayed data collection systems to a specific need expressed by the State of Mississippi to determine the feasibility of continuous near real time monitoring of data collection platforms to be placed in the Pearl River near Jackson, Mississippi. This document is intended to describe the cooperative efforts involved in the demonstration project including the plans, schedules, interagency commitments, and goals of the project.

2.0 NASA/MSFC PARTICIPATION

Data Systems Laboratory
Point-of-Contact - Mr. Rex Morton
NASA-AC-205-453-0991
Huntsville, Alabama

NASA/Marshall Space Flight Center (MSFC) will provide three data collection platforms (DCP), with sensors to the Pearl River Basin Development District (PRBDD). Capability and operation of DCP's is described in paragraph 3.0. The three DCPs will be equipped with four sensors each to measure:

- Dissolved oxygen
- Temperature
- Conductivity
- Ph

An earth resources data buoy (ERDB) will house sensor electronics, transmitter timer, and batteries. The antenna is housed separately on a flotation platform. Each of the three DCPs will consist of one buoy, one antenna/flotation, one antenna cable, mooring lines, and anchors. NASA-MSFC will make a site survey and provide the three DCPs to the A&WPCC during February 1975. NASA-MSFC will furnish an on-site representative to assist with the deployment, check-out and on-the-job training of maintenance personnel.

Documentation will be provided as follows:

- Instructions for operating in-situ water quality analyzer (Hydrolab)
- Field operations and Maintenance Manual on ERTS-Data Collection Platform (General Electric)
- Interconnect Diagram ERTS Data Collection Buoys

NASA-MSFC will provide technical consulting services for data collection on an as-required basis to the Air and Water Pollution Control Commission (A&WPCC). Figure 1 is an artist sketch of a typical data collection platform (A&WPCC DCPs will be packaged in a MSFC-designed buoy).

Table 1 is a summary of ERTS Data Collection Platform Characteristics.

NASA-MSFC will provide calibration data on individual sensors to NSTL so that received data may be converted by NSTL into engineering units prior to transmission to A&WPCC.

3.0 PEARL RIVER BASIN DEVELOPMENT DISTRICT, STATE OF MISSISSIPPI

Point-of-Contact - Mr. Alvin Beck
AC 601-354-6301
Jackson, Mississippi

The Pearl River Basin Development District will furnish a suitable boat, a crane capable of hoisting 400 pounds, and personnel for installation of data buoys/antennas at three locations (see Figure 2). Boat, crane, and installation personnel shall be available during the first week in February 1975. On-the-job training will be conducted by NASA-MSFC in operations and maintenance of buoy/DCPs for personnel selected by Pearl River Basin Development District. After deployment and during the demonstration period, NASA-MSFC should be contacted in case of equipment failure. Pearl River Basin Development District will review the boat, crane, and operating procedures with NASA-MSFC to ensure compatability prior to deployment.

4.0 NASA-NSTL PARTICIPATION

Point-of-Contact - Mr. Henry Auter
AC-601-688-2125
Bay St. Louis, Mississippi

A project systems document will be prepared by NASA-NSTL and coordinated with participating agencies before the project begins. NASA-NSTL will provide equipment and personnel to receive the water quality data from the three DCPs and transmit this data over an A&WPCC telephone line to A&WPCC computers in Jackson, Miss. Initially, NSTL will track, process data, convert to engineering units, and transmit data daily, Moaday through Friday, to A&WPCC. This data will normally be transmitted to A&WPCC computers in approximately 15 minutes after an ERTS pass. Exact times of data transmissions will be coordinated between NSTL and A&WPCC. Telephone line rental (call-up basis) and telephone company MODEM/coupler will be provided to NSTL by A&WPCC.

NSTL has synchronous and asynchronous communications capabilities for transmitting data to A&WPCC computer facilities. Data rates, formats, etc., will be negotiated between NSTL and A&WPCC.

NASA-NSTL will coordinate and host periodic evaluation and review meetings as shown on the project milestone schedule, page 7 and will prepare, with the assistance of participating agencies, a project report at the conclusion of the project.

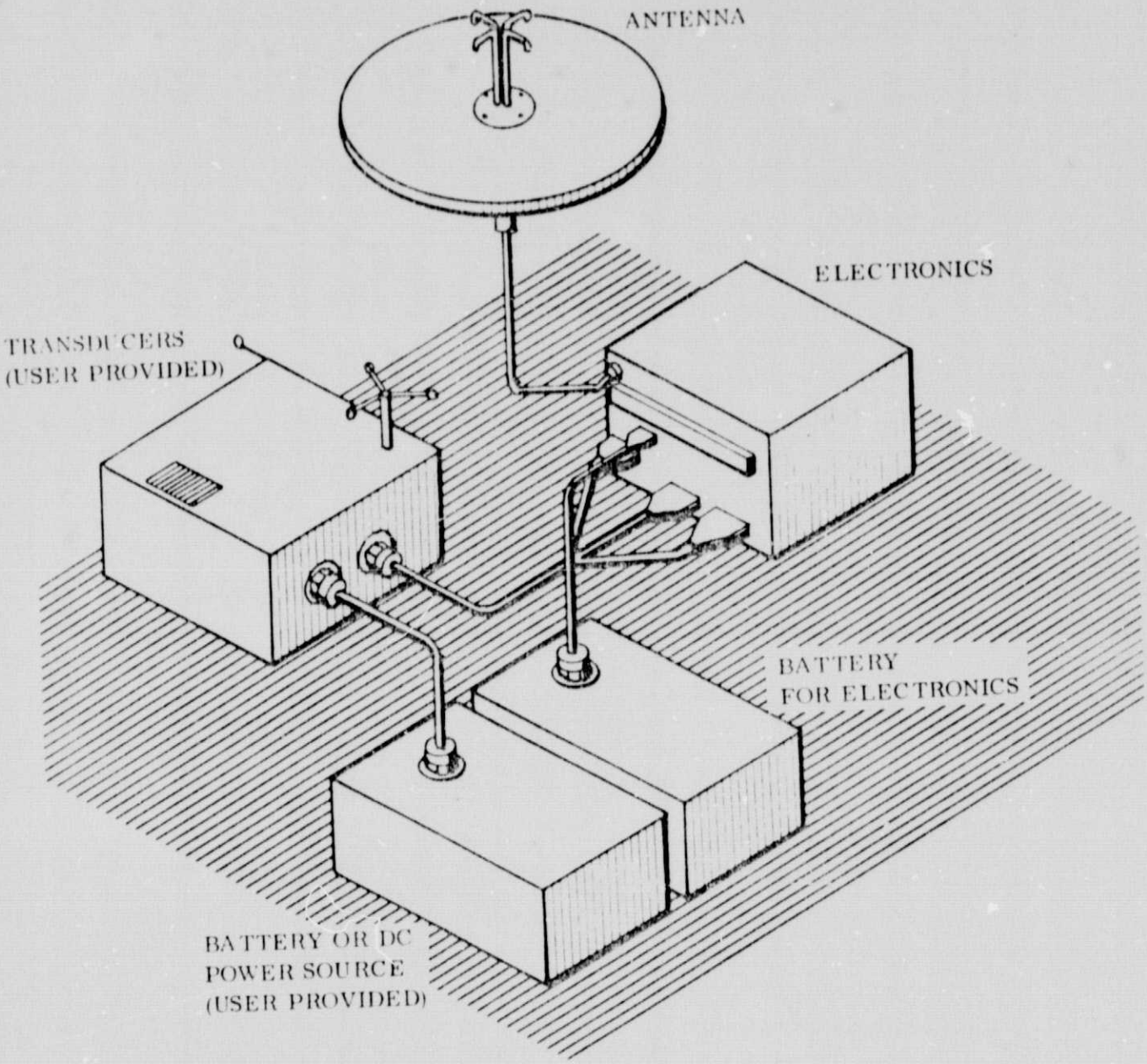
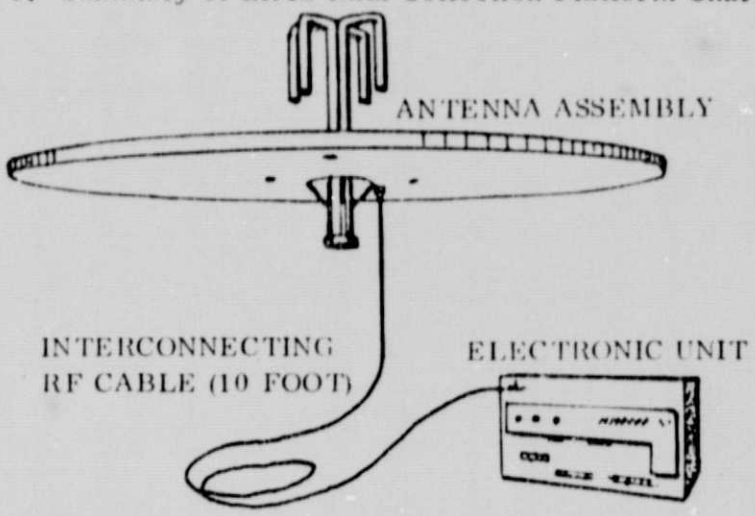


Figure 1. Artists Sketch of Typical Data Collection Platform

Table 1. Summary of ERTS Data Collection Platform Characteristics



ANTENNA	
Electrical:	
• Type	Crossed dipole with a bifolium radiation pattern
• Impedance	50 ohm nominal
Mechanical:	
• Reflector Size	46-inch reflector disc
• Weight	21 lbs.
• Mounting Provision	2-inch pipe clamp at base
ELECTRONIC UNIT	
Electrical:	
• Signal Input	8 analog channels (0-5V), or eight 8-bit serial digital words, or eight 8-bit parallel digital words, or combination of the above in 8 word message format.
• Power Input	24 ± 3 Vdc
• Transmitter	FM, 5 watts output (minimum)
• Frequency	401.55 MHz
• Power Drain	56 watts for 38 milliseconds (during transmissions) 70 milliwatts average power (maximum)
Mechanical:	
• Size	10.5 x 8.5 x 6.0 inches
• Weight	15 lbs. (maximum)
• Environment	
Temperature-Operating	-40°F to 125°F
Relative Humidity	0% to 97%, with condensation
Altitude	-260 ft to +17,500 ft.

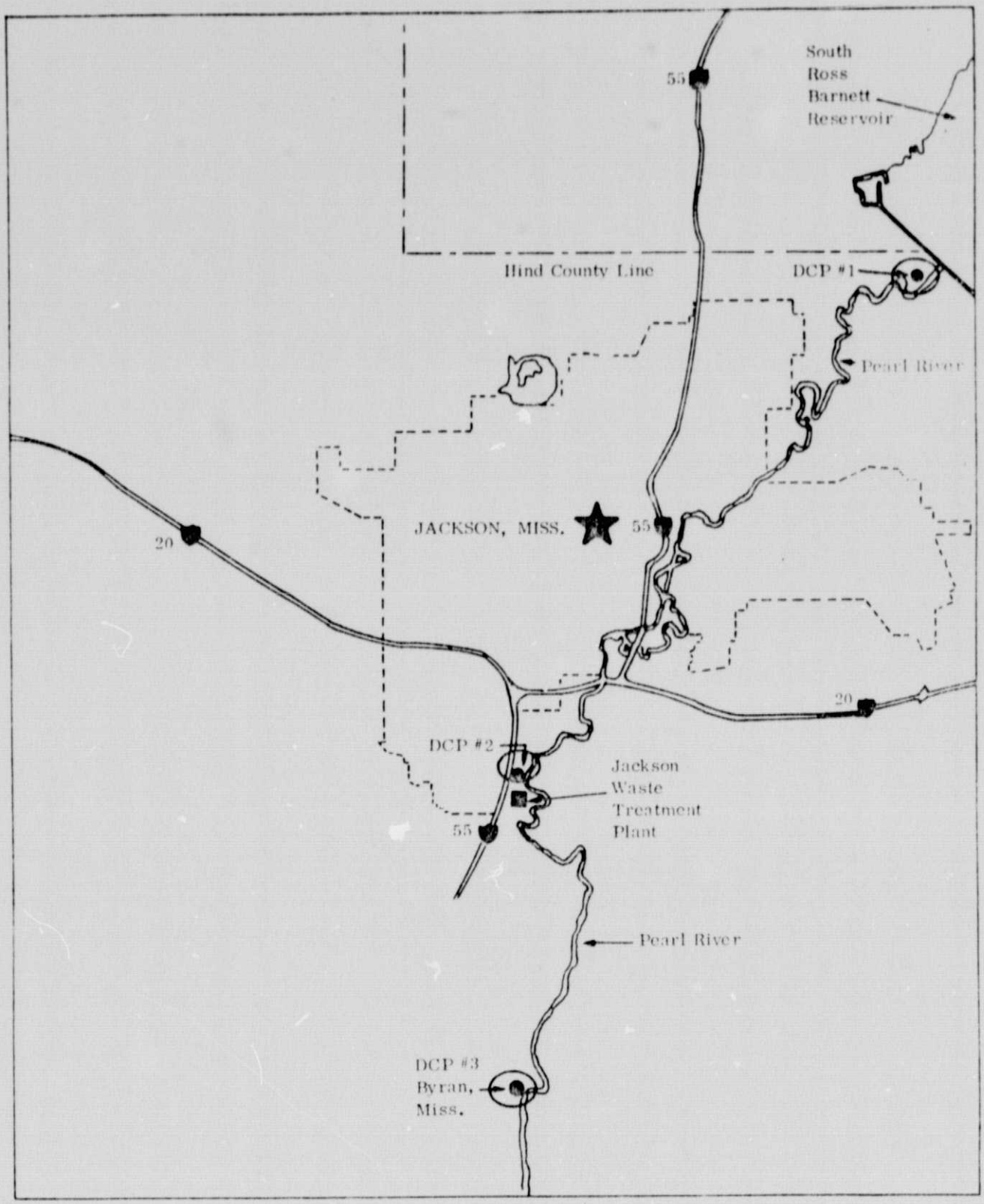


Figure 2. Approximate Locations of Deployment Earth Resources Data Buoys

This project is planned to be the first direct computer to computer transmission of data from the NSTL Satellite Data Acquisition and Processing System.

5.0 AIR AND WATER POLLUTION CONTROL COMMISSION, STATE OF MISSISSIPPI

Point-of-Contact - Mr. John Smith
AC-601-354-7513
Jackson, Mississippi

A&WPCC is responsible for coordination with NASA-MSFC, NASA-NSTL/Mississippi State University, and Pearl River Basin Development District in a cooperative satellite data relay project to demonstrate the feasibility and operational costs of continuous water quality monitoring stations. A&WPCC is responsible for evaluating and analyzing data transmitted by NSTL. Frequency of data, formats, etc., will be provided to NSTL. Costs of communications line to NSTL and MODEM/coupler terminal at NSTL will be the responsibility of A&WPCC.

NASA-NSTL will be reimbursed on a "cost additive" basis for costs incurred as a direct result of this project. Arrangements for transfer of funds to NSTL will be made through the Office of the Governor, Mississippi Office of Science and Technology located at NSTL.

6.0 ERTS RELAY SYSTEM

Data collection platforms were originally developed to demonstrate the use of satellites for collecting information simultaneously from a large area. The Earth Resources Technology Satellite (ERTS) spacecraft acts as a simple relay: receiving, frequency translating, and retransmitting the burst messages from the DCPs. No on-board recording, processing, or decoding of the data is performed. Unified S-Band (USB) equipment, used for narrow band telemetry, is used to retransmit the DCP messages to the receiving sites. Continuation of data collection is planned throughout the 1970's by employing ERTS-B and ERTS-C satellites.

The three DCPs to be installed in the vicinity of Jackson, Mississippi, are well within a mutually visible range of DCPs/ERTS Satellite/NSTL. During high elevation ERTS passes, it is possible to receive up to three separate transmissions from a DCP (three minutes apart) from each orbital pass of the satellite. These high elevation passes occur at NSTL about 9:30 AM and 9:30 PM Central Standard Time. At least one message can be relayed from each platform every 12 hours with a two-shift operation.

7.0 MILESTONE SCHEDULE

The Pearl River Data Collection System Applications Project milestone schedule is shown on Table 2.

Table 2. Milestone Schedule